DOCUMENT RESUME

ED 159 018 SE 024 792

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TITLE	Metric Education: We Are Getting Ready for the Change. Module on Volume and Capacity.
INSTITUTION	Albany-Schoharie-Schenectady Board of Cooperative Educational Services, Albany, N.Y.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	77
GRANT	OE-007700843
NOTE	13p.; For related documents, see SE 024 788-791; Contains occasional light and broken type
EDRS PRICE	MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS	*Activity Units; Elementary Education; *Elementary School Mathematics; *Instructional Materials; *Measurement; *Metric System; *Resource Materials; Resource Units
IDENTIFIERS	Capacity; *Volume

ABSTRACT

This module is one of five modules on length, area, volume and capacity, mass, and temperature, developed for the use of teachers and teacher-trainer team leaders. Primary and intermediate activities in this booklet concentrate on the concepts of volume and capacity with emphasis on metric measurement. The objectives and needed materials for each activity are listed. (MN)

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PROJECT:

"METRIC EDUCATION: WE ARE GETTING READY FOR THE CHANGE"

MODULE ON VOLUME AND CAPACITY

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1977

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The preparation of this Module was supported in part by the U.S. Office of Education, Department of Health, Education, and Welfare under the Grant #007700843. However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S. Office of Education, and no official endorsement by the U.S. Office of Education should be inferred.

INTRODUCTION

This module on volume and capacity is one of the five modules, on length, area, volume and capacity, mass, and temperature, developed, for the use of teachers and teacher-trainer team leaders, as a product from the Project "Metric Education: We are Getting Ready for the Change."

Parts of this module were developed and tried during the recent workshops conducted for the BOCES level team leaders. Participants of these workshops made a significant contribution in the development of this module.

The activities incorporated in this module are only suggestive in nature and teachers are free to modify them according to their classroom needs.

December 1977

Piyush C. Agrawal
Project Director

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SECTION 1

P R I M A R Y

OBJECTIVE 1: To provide experiences in the measurement of capacity using non-standard units.

MATERIALS: Various size and shape plastic containers with caps; plastic cups; sand or rice; water.

ACTIVITIES: Fill various size and shape containers. Children measure how many capfuls, cupfuls, etc. fill each container and count and record this information.

* * * *

OBJECTIVE 2: To provide experiences in the measurement of capacity by establishing a standard unit of measurement.

MATERIALS: Small juice cans, 1-liter container

ACTIVITIES:
1) Fill juice can with water and pour water into liter container. Continue until liter container is full.
2) Find out how many juice cans it took to fill a liter.
3) If it took 4 juice cans to fill up a liter, then a juice can would be ¼ of a liter - that is the standard - if 5 juice cans, then 1/5 of a liter.
4) Use juice can standard to measure other containers.
5) See if you can find other containers that are the same standard as the juice can.

* * * *

OBJECTIVE 3: To help develop an understanding of capacity as a "how much fits" measure, and to provide practice in counting, measure, and recording.

MATERIALS:
1) One small cup
2) One large cup
3) Variety of filling materials (rice, sand, water, beads, etc.)

ACTIVITIES:
1) Use a small cup to fill a big cup.
2) Do this experiment many times using a different filling material.
3) Record results for each material used.
4) Ask how many of the little cups filled the big one. Was it the same or different for each experiment.
5) Ask if they think there is a best filler to use and why.

* * * *

OBJECTIVE 4: To estimate and then measure the amount of liquid needed to fill an aquarium.

MATERIALS: Aquarium, water, assorted containers

ACTIVITIES:
1) Estimate how many containers (your choice) of water the aquarium holds.
2) Fill it and find out.
3) How close was your guess?

OBJECTIVE 5: To introduce the attributes of containers and volume concepts.

MATERIALS: Assorted containers

ACTIVITIES:
1) Have students bring in empty containers used for food, clothing, etc.
2) Discuss containers including discussion in variation of shape, size, material, weight, purpose, durability
3) Have pupils sort the containers with attributes as discussed.

* * * *

OBJECTIVE 6: 1. Given several various size and shape containers the youngster will be able to:
   a) "Measure" the amount of liquid or material using non-standard units.
   b) Determine, by measuring with non-standard units, how to order the containers from the one which holds the least to the one that holds the most.

MATERIALS: Various size containers; plastic cups.

ACTIVITIES: Have several different bottles of different size and shape. Have students guess which holds the most? the least? Measure to determine. Order the containers from least to most.

* * * *

OBJECTIVE 7: To enable children to develop an understanding that volume is a measure of "how much" fits in a space.

MATERIALS: Various size blocks and containers. Two identical bottles and one other container of a different shape.

ACTIVITIES: Children estimate how many large blocks will fit into a box. Record and then check. Children estimate how many cubes will fill a container. Record and then check.

* * * *

OBJECTIVE 8: To have the students understand the basic terminology of standard measures of capacity.

MATERIALS: Milk cartons, juice cans, jars, standard measuring cups, liter container.

ACTIVITIES: Ask the class questions relating to volume using non-standard measures. (e.g. juice cans, jars, etc.)

Divide the class into small groups and have them determine the volume of particular containers. Compare answers.

Have students measure the volume of the containers in terms of liters. Which are more than a liter? Less than a liter?

OBJECTIVE 9: To construct an object having the same volume as a model.

MATERIALS: Set of blocks for each group (metric size perferred).

ACTIVITIES:

1) Teacher builds a model building with identically sized blocks (call a block a room).
2) Break class into small groups - have each group build as many buildings as it can that have the same number of rooms as the teachers. The teacher's building cannot be moved by the students but they may count the number of rooms in it.
3) Tell students that their buildings do not have to look exactly like yours.
4) After activity is completed, have groups check their buildings by counting the number of blocks in the teachers building and matching their number of blocks to the teachers.
5) Be sure students understand that there are different ways a building could be constructed having the same number of rooms (same volume).

SECTION 2

INTERMEDIATE

OBJECTIVE 1: Have students develop their ability to measure given amounts of liquid in terms of liters.

MATERIALS: Liter containers, decimeter cube, metric ruler, container marked in milliliters.

ACTIVITIES: Using a liter container, have students find the capacity of a given container to the nearest liter. Record using proper symbol.

Given two irregular containers, have the student determine, using a liter container, which has the greater capacity.

* * * *

OBJECTIVE 2: Provide opportunities for students to measure liquids in milliliters and liters.

MATERIALS: Liter measuring containers, graduated cylinders (ml), metric measuring cups, various containers.

ACTIVITIES: Fill several containers with water. Estimate the number of milliliters each contains to the nearest 100 ml. Use liter containers and graduated cylinders to more accurately determine the capacity of each item.

* * * *

OBJECTIVE 3: To have students develop the ability to estimate capacity of containers.

MATERIALS: Milk cartons, jars, cans, liter containers, meter sticks, metric rulers.

ACTIVITIES: Have students fill containers of various sizes and shapes (regular) and estimate capacity. Cylinderical containers could be estimated in terms of liters of milliliters. Rectangular containers could be estimated in terms of cubic centimeters or cubic meters.

Have students measure amounts of liquid in containers which measure in cubic centimeters and then in milliliters. Compare the findings.

* * * *

OBJECTIVE 4: Develop the student's ability to measure volume of a cube.

MATERIALS: Decimeter cube; centimeter cubes; various size boxes, metric rulers (cm).

ACTIVITIES: Measure the sides of a decimeter cube. How many cubes does it take to fill the bottom? How many cm cubes will fit into the decimeter cube.

Measure the sides of various boxes. How many centimeter cubes would it take to fill the box?

OBJECTIVE 5: To find the volume of an irregular shaped object, say a rock.

MATERIALS: Small rock, straw, string, big paper cup, small paper cup, centimeter ruler, metric measuring cup.

ACTIVITIES:
1) Take a straw - measure it and cut off 5 cm.
2) Measure 2cm down from top of big paper cup and push straw through it.
3) Cut end of straw on outside of cup on an angle.
4) Put smaller paper cup below straw.
5) Fill larger cup to top with water - then water will run out to the smaller cup until it settles below the straw.
6) Empty smaller paper cup and put it back under straw.
7) Put string around rock and lower carefully into big cup. Water will flow into smaller cup.
8) Wait until it stops and then measure the amount of water in small cup.
9) The amount of water is the volume of rock.
10) Ex. if water measures 40 ml - then the volume of the rock is 40 ml.

* * * *

OBJECTIVE 6: To use the volume formula to find the volume of an object.

MATERIALS: Centimeter ruler, pencil, paper, books of assorted sizes.

ACTIVITIES:
1) Measure the length, width, and height of a book.
2) Find the volume of the book by multiplying the length times width times height.
$V = L \times W \times H$
3) Find volume of other objects.

* * * *

OBJECTIVE 7: To develop an understanding of the relationshop between cubic measure (cm^3, dm^3) and capacity measure (ml, l).

MATERIALS: Centimeter cubes, decimeter cubes, liter containers, beakers (ml). metric rulers.

ACTIVITIES: Using the materials listed have students:
1) Measure the sides of the various cubes (cm^3, dm^3).
2) Use cm^3 to determine surface area and cubic measure of the dm^3.
3) Fill the dm^3 with liquid. Compare this with the capacity of a liter container.

OBJECTIVE 8: To read and follow directions in a metric recipe.

MATERIALS: Measuring cups and spoons (metric), recipe.

ACTIVITY: Follow directions for making banana bread.

Preheat oven to 180 °C
Grease 22 x 12 x 7 cm loaf pan
Sift together 500 ml flour, 125 ml granulated sugar, 15 ml baking powder, 2 ml baking soda, 2 ml salt.
Stir in 125 ml finely chopped nuts
Beat together 1 egg, 200 ml milk, 50 ml vegetable oil or melted shortening, 350 ml. mashed ripe bananas.
Add liquid to dry ingredients and beat for about half a minute.
Turn into prepared pan.
Bake in preheated 180 °C oven for 65 to 70 minutes.